Remarks

Reconsideration of this application is respectfully requested in view of the foregoing amendments and following remarks. Claims 1-10, 13-29, 32-38, 96-101, 103-120, 122-128, and 130-132 are currently pending. Claims 1, 20-23, 115, and 128 have been amended. No new matter has been added. Therefore, upon entry of this amendment, claims 1-10, 13-29, 32-38, 96-101, 103-120, 122-128, and 130-132 will be pending.

Rejections under 35 U.S.C. § 112, First Paragraph

Claims 17, 36, and 126 are rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement. Specifically, the Examiner alleges the recitation of "said cathode layer comprises a substantially homogenous mixture of a copper-substituted ferrite material and a finely-divided form of a second material" in claims 17 and 36 is not present in the specification as originally filed. The Examiner's assertion is incorrect.

As stated in MPEP § 2163.04, "A description as filed is presumed to be adequate, unless or until sufficient evidence or reasoning to the contrary has been presented by the examiner to rebut the presumption." See, *e.g.*, *In re Marzocchi*, 439 F.2d 220, 224, 169 USPQ 367, 370 (CCPA 1971). As explained previously in Applicants' August 12, 2008, Amendment, the originally filed specification states, "In another embodiment, the cathode layer comprises a substantially homogenous mixture of a copper-substituted ferrite material made or selected in accordance with the invention and a finely-divided form of another material, such as, for example, a conductive material." (Page 19, ll. 4-7.) Therefore, in the absence of sufficient evidence or reason to the contrary, the specification as filed clearly provides adequate written description support for claims 17, 36, and 126. Applicants request withdrawal of the rejection.

If the Examiner persists in this rejection, Applicants respectfully ask that the Examiner explain why the above-quoted passage does not provide written description support.

Rejections under 35 U.S.C. § 103(a)

Claims 1-10, 15-19, 112, 113, and 115 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Aizawa *et al.* (U.S. Patent No. 6,692,855) in view of Kindermann *et al.* (*J. Am. Ceram. Soc.*, 80[4], 909-914 (1997)). Applicants traverse.

Amended claim 1 recites a solid oxide fuel cell (SOFC) wherein the cathode comprises a copper-substituted ferrite perovskite material, and the SOFC is operable at temperatures less than about 750 °C. Support for the amendment is found throughout the specification, *e.g.*, at page 23, ll. 8-10.

The Examiner acknowledges that neither Aizawa nor Kindermann discloses a SOFC cathode made from a copper-substituted ferrite perovskite material. However, because Kindermann discloses ferrite perovskite formulas comprising Mn, Ni, Co, or Cr, the Examiner alleges that one of ordinary skill in the art would have been motivated to use Cu in the perovskite material taught by Kindermann. The Examiner also alleges that Aizawa teaches copper as a dopant in a lanthanum perovskite material, and that an artisan would have found the claimed invention to be obvious. Applicants disagree.

Aizawa discloses cathodes comprising $(Ln_{1-x}Sr_x)_{1-a}MnO_3$ or $(Ln_{1-x}Ca_x)_{1-a}MnO_3$ where Ln is at least one of La, Ce, Nd, Pr and Sm. (Col. 6, ll. 33-44.) Kindermann discloses cathodes comprising $La_{0.6}Sr_{0.4}Fe_{0.8}M_{0.2}O_{3-\delta}$, $(La_{0.6}Sr_{0.4})_{0.9}Fe_{0.8}M_{0.2}O_{3-\delta}$, $La_{0.6}Ca_{0.4}Fe_{0.8}M_{0.2}O_{3-\delta}$, or $(La_{0.6}Ca_{0.4})_{0.9}Fe_{0.8}M_{0.2}O_{3-\delta}$ where M is Cr, Mn, Ni, or Co. (Page 909, column 2.)

Aizawa discloses $(Ln_{1-x}Sr_x)_{1-a}MnO_3$ or $(Ln_{1-x}Ca_x)_{1-a}MnO_3$ as potential SOFC cathode materials. However, Aizawa does not teach or suggest using any transition metal other than Mn. Further, Aizawa discloses the presence of iron only as a minor dopant in amounts ranging from 0.01 wt% to 0.5 wt%. (Col. 6, ll. 62-65.) The Examiner alleges that Aizawa discloses "copper as a dopant in a lanthanum perovskite material." However, the copper containing material disclosed in Aizawa *et al.* is for use as a tight ceramic film forming an interconnect. (Col. 17, ll. 8-15, and col. 18, ll. 40-49) The material is not used as a cathode. Additionally, the material is a lanthanum chromite, not a lanthanum ferrite material as presently claimed.

Kindermann discloses SOFC cathodes comprising transition metal-substituted lanthanum ferrite perovskites, where the transition metal is selected from Cr, Mn, Ni, or Co. (Page 909, col. 2.) There is no teaching or suggestion in Kindermann to select any transition metal other than the four listed metals. Further, Kindermann provides no discussion of the respective merits of the transition metals listed. Simply because copper is also a transition metal does not mean that a person of ordinary skill in the art at the time of the invention would have predicted any gainful benefit attributable to copper compared to other transition metals in the context of lanthanum ferrite perovskite.

Applicants, however, discovered that copper-substituted ferrite perovskite cathodes have increased current density, increased conductivity, lower area-specific resistance, and lower polarization resistances compared to unsubstituted cathodes. (Specification, pp. 30-32, FIGS. 6, 7, 9, and 11.) Applicants also discovered that SOFCs having cathodes comprising copper-substituted ferrite perovskite materials can be operated at lower temperatures (*e.g.*, at temperatures less than 750 °C) than comparable SOFCs without copper-substituted ferrite perovskite cathodes. In contrast, Aizawa's SOFCs operate at 1000 °C. (See, *e.g.*, col. 24, ll. 36-

37; col. 30, ll. 39-41.) The Examiner alleges that Aizawa discloses "said fuel cell has a power density of at least about 1.0 W/cm^2 at 750°C and 0.7V." (Office action, page 3.) However, Applicants do not find such disclosure in Aizawa and respectfully request that the Examiner indicate where such disclosure is found in Aizawa. Kindermann provides no data regarding SOFC operation.

Thus, claim 1 is allowable in view of the combination of Aizawa and Kindermann, and Applicants request withdrawal of the rejection. Claims 2-10, 15-19, 112, and 113 depend directly or indirectly from claim 1 and also are allowable for at least the reasons discussed above.

With respect to claims 2 and 5-7, the Examiner contends that Aizawa modified by Kindermann teaches a fuel cell including a cathode layer of a perovskite composition having the formula:

$$La_{1-x-x'}Sr_xA'_{x'}Fe_{1-y-y'}M_yB'_{y'}O_3$$

wherein x is from about 0.05 to about 0.4; y is from about 0.01 to about 0.05; x' is from 0 to about 0.4, y' is from 0 to about 0.4; A' is an A-site dopant, and B' is a B-site dopant. (Office action, pp. 4-5.) This conclusion is incorrect.

Applicants can find no support in either Aizawa or Kindermann for the above formula and substituent ranges, and respectfully request that the Examiner indicate where such support can be found. As previously discussed in relation to claim 1, Aizawa discloses $(Ln_{1-x}Sr_x)_{1-a}MnO_3$ or $(Ln_{1-x}Ca_x)_{1-a}MnO_3$. Kindermann discloses the general formula $(La_{1-x}Sr_x)_zFe_{1-y}Mn_yO_{3-\delta}$ ($0\leq x\leq 0.3$; $0.2\leq y\leq 1$; z = 0.90, 0.95, 1.00). (Page 909, col. 2.) Neither reference discloses a lanthanum ferrite formula including strontium plus another A-site dopant and two B-site dopants.

Claims 8 and 112 recite "wherein the copper-substituted lanthanum ferrite material further comprises at least one B-site dopant selected from the group consisting of nickel, cobalt,

manganese, aluminum, and chromium." Claim 113 recites the B-site dopant is manganese. Kindermann does not disclose a copper-substituted lanthanum ferrite material. Kindermann's formulas represent a transition-metal substituted lanthanum ferrite, where the transition metal is Cr, Mn, Ni, or Co. Moreover, Kindermann neither teaches nor suggests a material having <u>two</u> B-site dopants. The material of claims 8, 112, and 113 comprises two B-site dopants: Cu and another dopant selected from the group listed. Aizawa also does not teach or suggest a copper-substituted lanthanum ferrite material having two B-site dopants.

With respect to claims 9 and 10, the Examiner again provides the formula discussed above in relation to claims 2 and 5-7, and states that one of ordinary skill in the art would have been motivated to use Cu as M in the lithium ferrite perovskite material taught by Kindermann. It is assumed the Examiner means the *lanthanum* ferrite perovskite material of Kindermann. Kindermann, however, does not disclose the referenced formula. Nor does Kindermann teach or suggest using Cu as M. As set forth above in relation to claim 1, there is no suggestion or motivation provided by Kindermann or Aizawa to select copper in place of the transition metals listed by Kindermann. Additionally, as previously discussed, Aizawa teaches copper as a dopant in an interconnect material comprising lanthanum chromite, but does not teach or suggest copper as a dopant in a lanthanum ferrite material for use as a SOFC cathode. Thus, although the polarization resistance values of claims 9 and 10 may indeed be inherent to the claimed material, the combination of Aizawa and Kindermann fails to teach the copper-substituted ferrite perovskite material of claim 1.

Claim 15 recites that "the copper-substituted ferrite material comprises essentially the entire cathode layer," and claim 16 recites, that the "copper substituted ferrite material comprises at least about 25% of said cathode layer." The Examiner alleges it is inherent that the copper-

substituted ferrite material of Aizawa modified by Kindermann comprises essentially the entire cathode layer. (Office action, page 6.) However, as discussed above, the combination of Aizawa and Kindermann does not teach the claimed copper-substituted ferrite material.

Claim 115 recites a SOFC with a cathode comprising "a copper-substituted lanthanum ferrite perovskite material that includes at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum and chromium; wherein said solid oxide fuel cell is operable at temperatures less than about 750 °C." As discussed above in relation to claims 1, 8, and 112, Kindermann does not disclose a copper-substituted lanthanum ferrite material or a material having two B-site dopants, *i.e.*, copper plus another dopant. Aizawa also does not teach or suggest a copper-substituted lanthanum ferrite material having a second B-site dopant. Neither reference discloses a SOFC operable at temperatures less than about 750 °C. Thus, claim 115 is allowable over the cited prior art, and Applicants request withdrawal of the rejection.

Claims 13, 14, 18, 32, 33, 122 and 123 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Aizawa *et al.* in view of Kindermann *et al.*, and in view of Badding *et al.* (U.S. Publication No. 2001/0044041 A1). Applicants traverse.

Claims 13 and 14 depend from claim 1 and recite a copper-substituted ferrite material comprising a layer having a thickness of from about 1 to about 50 microns, or from about 1 to about 30 microns, respectively. Claims 122 and 123 depend from claim 115 and recite the same elements as claims 13 and 14. Badding discloses SOFCs having electrode thicknesses between 0.1 and 50 microns. (Col. 5, paragraph [0055]). However, Badding does not teach or suggest

copper-substituted ferrite perovskite materials as cathodes for SOFCs. Accordingly, Badding cannot overcome the deficiencies of Aizawa and Kindermann.

Claim 18 depends from claim 1, but does not recite a thickness limitation for the cathode layer. Applicants do not see the relevance of the present rejection to claim 18 and respectfully request that the Examiner clarify the rejection. However, because claim 1 is allowable over the cited art, claim 18 must necessarily be allowable as well.

Claims 32 and 33 depend from claim 20. Since claim 20 was not rejected in view of Aizawa and Kindermann, it is unclear why the Examiner has rejected these claims in view of Badding. Nonetheless, Aizawa and Kindermann do not teach or suggest the copper-substituted ferrite perovskite composition of claim 20, as discussed above in relation to claim 1, and Badding does not cure the deficiency of Aizawa combined with Kindermann.

For at least the reasons discussed above, claims 13, 14, 18, 32, 33, 122, and 123 are allowable over the cited prior art. Applicants request withdrawal of the rejection.

Claims 1, 20-29, 32-38, 112-120, 124, 125, 127, and 128 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Aizawa *et al.* in view of Förthmann *et al.* ("Ceramic coatings for cathode contacts of solid oxide fuel cells," Materials Week '98, Volume III, Symp. 3, Energy Engineering Workshop, 68TKAJ, 149-154, 1999) and further in view of Kindermann *et al.* Applicants traverse.

Claims 1, 20, 115, and 128 are independent claims. Each claim recites a SOFC having a cathode comprising a copper-substituted ferrite perovskite material, and recites that the SOFC is operable at temperatures less than about 750 °C. Claims 115 and 128 additionally recite that the

copper-substituted ferrite perovskite material further comprises at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum and chromium.

As previously discussed, the combination of Aizawa and Kindermann does not teach a copper-substituted ferrite perovskite. Also, neither reference teaches a SOFC that is operable at temperatures less than about 750 °C. Förthmann discloses contact coatings that are placed between cathodes and interconnectors of fuel cell stacks comprising individual SOFCs connected to each other through electrically conductive interconnectors. (Förthmann, page 149.) Förthmann discloses several compositions, including $La_{0.6}Sr_{0.4}Fe_{0.8}Cu_{0.2}O_3$ ("LSFK"). However, Förthmann indicates that the substituted lanthanum ferrite perovskites are less suitable than the other disclosed compositions: "[T]here is a pronounced chemical interaction of the substituted $LaFeO_3$ perovskites with the interconnector steel under formation of poorly conductive spinels (such as, for example, $FeCr_2O_4$) that increase the transitional resistance to the interconnector." (Förthmann, page 150.) In contrast, effective coatings "show no or only a negligible chemical interaction with the cathode and the interconnector." (Förthmann, page 149.) Thus, Förthmann actually teaches away from using the LSFK formulation. Also, Förthmann does not teach or suggest using the substituted lanthanum ferrite perovskite compositions as cathode materials. Förthmann only discloses their use as a contact coating between the cathode and the interconnector. Finally, Förthmann does not teach or suggest a SOFC that is operable at temperatures of less than about 750 °C. Förthmann discloses only that the coatings were sintered at 900 °C, and contact resistances were measured at 800 °C. (Förthmann, pp. 152-153.)

Thus, the combination of Aizawa, Förthmann, and Kindermann fails to teach the features of independent claims 1, 20, 115, and 128, and these claims are allowable over the cited prior art. Claims 21-29, 32-38, and 114 depend directly or indirectly from claim 20. Claims 112 and 113

depend directly or indirectly from claim 1. Claims 116-119, 124, 125, and 127 depend directly or indirectly from claim 115. Accordingly, claims 1, 20-29, 32-38, 112-120, 124, 125, 127, and 128 are allowable, and Applicants respectfully request withdrawal of the rejection.

Claims 130-132 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Aizawa *et al.* in view of Förthmann *et al.* and further in view of Kindermann *et al.* Applicants traverse.

Claims 130, 131, and 132 depend from claims 1, 20, and 115, respectively. As set forth above, claims 1, 20, and 115 are allowable over the combination of Aizawa, Förthmann, and Kindermann. Hence, claims 130-132 necessarily are allowable as well.

Conclusion

The claims in their present form should now be allowable. Such action is respectfully requested. The Examiner is invited to contact the undersigned at the telephone number listed below if such a call would facilitate allowance of this application.

Respectfully submitted,

KLARQUIST SPARKMAN, LLP

One World Trade Center, Suite 1600
121 S.W. Salmon Street
Portland, Oregon 97204
Telephone: (503) 595-5300
Facsimile: (503) 595-5301

By Gillian Gardner
Gillian Gardner
Registration No. 62,755